

Claims

- [c1] An electro-optic display comprising first and second substrates and a lamination adhesive layer and a layer of a solid electro-optic material disposed between the first and second substrates, the lamination adhesive layer having a volume resistivity, measured at 10 ° C, which does not change by a factor of more than about 3 after being held at 25 ° C and 45 per cent relative humidity for 1000 hours.
- [c2] An electro-optic display according to claim 1 wherein the volume resistivity of the lamination adhesive measured at 10 ° C does not change by a factor of more than about 2 after being held at 25 ° C and 45 per cent relative humidity for 1000 hours.
- [c3] An electro-optic display according to claim 2 wherein the volume resistivity of the lamination adhesive measured at 10 ° C does not change by a factor of more than about 1.5 after being held at 25 ° C and 45 per cent relative humidity for 1000 hours.
- [c4] An electro-optic display according to claim 1 wherein the lamination adhesive layer is essentially free from plasticizer.
- [c5] An electro-optic display according to claim 1 wherein the lamination adhesive layer exhibits a change in the enthalpy associated with any phase transition in the material, as measured by differential scanning calorimetry, that is not more than about 2 Joules per gram after being held at 25 ° C and 45 per cent relative humidity for 1000 hours.
- [c6] An electro-optic display according to claim 1 wherein the lamination adhesive layer exhibits a change in dielectric constant of less than about 2 after being held at 25 ° C and 45 per cent relative humidity for 1000 hours.
- [c7] An electro-optic display according to claim 1 wherein the lamination adhesive comprises a blend of at least two materials.
- [c8] An electro-optic display according to claim 1 wherein the lamination adhesive comprises a blend of at least two lamination adhesives, at least one of which

has a volume resistivity, measured at 10 ° C, which changes by a factor of more than 3 after being held at 25 ° C and 45 per cent relative humidity for 1000 hours.

- [c9] An electro-optic display according to claim 1 wherein the lamination adhesive comprises at least one polyurethane.
- [c10] An electro-optic display according to claim 9 wherein the lamination adhesive comprises a blend of at least two polyurethanes.
- [c11] An electro-optic display according to claim 10 wherein the lamination adhesive comprises a blend of a non-ionically stabilized polyester-based polyurethane and an anionically stabilized polyester-based polyurethane.
- [c12] An electro-optic display according to claim 1 wherein the lamination adhesive has a volume resistivity, measured at 10 ° C, of not more than about 3×10^{10} ohm cm.
- [c13] An electro-optic display according to claim 1 wherein the electro-optic medium comprises a rotating bichromal member, electrochromic, encapsulated liquid crystal or microcell electrophoretic medium.
- [c14] An electro-optic display according to claim 1 wherein the electro-optic medium comprises an electrophoretic medium comprising a plurality of capsules, each capsule comprising a capsule wall and an internal phase encapsulated within capsule wall, the internal phase comprising electrically charged particles suspended in a suspending fluid and capable of moving through the fluid on application of an electric field to the electrophoretic material.
- [c15] An electro-optic display according to claim 14 further comprising a polymeric binder within which the capsules are held.
- [c16] An electro-optic display according to claim 14 further comprising at least one electrode disposed between the electro-optic medium and one of the substrates, this electrode being arranged to apply an electric field to the electro-optic medium.

- [c17] An electro-optic display according to claim 16 comprising two electrodes disposed on opposed sides of the electro-optic medium and between the electro-optic medium and the two substrates, at least one of the electrodes and the adjacent substrate being light-transmissive such that the electro-optic medium can be viewed through the light-transmissive substrate and electrode.
- [c18] A process for preparing an electro-optic display by providing a first subassembly comprising an electro-optic layer and a first substrate, providing a second subassembly comprising a second substrate, at least one of said subassemblies comprising an electrode, and laminating the two subassemblies to one another using a lamination adhesive so that the electro-optic layer is disposed between the first and second substrates, the lamination adhesive having a volume resistivity, measured at 10 ° C, which does not change by a factor of more than about 3 after being held at 25 ° C and 45 per cent relative humidity for 1000 hours.
- [c19] A process according to claim 18 wherein the volume resistivity of the lamination adhesive measured at 10 ° C does not change by a factor of more than about 2 after being held at 25 ° C and 45 per cent relative humidity for 1000 hours.
- [c20] A process according to claim 19 wherein the volume resistivity of the lamination adhesive measured at 10 ° C does not change by a factor of more than about 1.5 after being held at 25 ° C and 45 per cent relative humidity for 1000 hours.
- [c21] A process according to claim 18 wherein the lamination adhesive layer is essentially free from plasticizer.
- [c22] A process according to claim 18 wherein the lamination adhesive layer exhibits a change in the enthalpy associated with any phase transition in the material, as measured by differential scanning calorimetry, that is not more than about 2 Joules per gram after being held at 25 ° C and 45 per cent relative humidity for 1000 hours.
- [c23] A process according to claim 18 wherein the lamination adhesive layer exhibits a change in dielectric constant of less than about 2 after being held at 25 ° C and 45 per cent relative humidity for 1000 hours.

- [c24] A process according to claim 18 wherein the lamination adhesive comprises a blend of at least two materials.
- [c25] A process according to claim 18 wherein the lamination adhesive comprises a blend of at least two lamination adhesives at least one of which has a volume resistivity, measured at 10 ° C, which changes by a factor of more than 3 after being held at 25 ° C and 45 per cent relative humidity for 1000 hours.
- [c26] A process according to claim 18 wherein the lamination adhesive comprises at least one polyurethane.
- [c27] A process according to claim 26 wherein the lamination adhesive comprises a blend of at least two polyurethanes.
- [c28] A process according to claim 27 wherein the lamination adhesive comprises a blend of a non-ionically stabilized polyester-based polyurethane and an anionically stabilized polyester-based polyurethane.
- [c29] A process according to claim 18 wherein the lamination adhesive has a volume resistivity, measured at 10 ° C, of not more than about 3×10^{10} ohm cm.
- [c30] A process according to claim 18 wherein the electro-optic medium comprises a rotating bichromal member, electrochromic, encapsulated liquid crystal or microcell electrophoretic medium.
- [c31] A process according to claim 18 wherein the electro-optic medium comprises an electrophoretic medium comprising a plurality of capsules, each capsule comprising a capsule wall and an internal phase encapsulated within the wall, the internal phase comprising electrically charged particles suspended in a suspending fluid and capable of moving through the fluid on application of an electric field to the electrophoretic medium.
- [c32] An electro-optic display comprising first and second substrates, and a lamination adhesive layer and a layer of solid electro-optic material disposed between the first and second substrates, the lamination adhesive being characterized by any one or more of the following:
 - (a) having a volume resistivity, measured at 10 ° C, which does not change by a

factor of more than about 3 after being held at 25 ° C and 45 per cent relative humidity for 1000 hours;

(b) having a peel strength from an electrode material in contact with the lamination adhesive of at least about 2 lb/inch;

(c) the volume resistivity of the lamination adhesive changes by a factor of less than about 10 within a range of 10 to 90 per cent relative humidity and over a temperature range of 10 to 50 ° C;

(d) the lamination adhesive has a thickness in the range of about 10 to about 20 μ m;

(e) the lamination adhesive has a shear modulus at 120 ° C of not more than about 1 megaPascal;

(f) the product of the dielectric constant and the volume resistivity of the lamination adhesive is not greater than the product of the dielectric constant and the volume resistivity of the electro-optic medium within a range of 10 to 90 per cent relative humidity and over a temperature range of 10 to 50 ° C;

(g) comprising an ultra-violet stabilizer;

(h) comprising a light absorbing material.

[c33] An electro-optic display according to claim 32 wherein the lamination adhesive has a peel strength from an electrode material in contact with the lamination adhesive of at least about 4 lb/inch.

[c34] An electro-optic display according to claim 32 wherein the volume resistivity of the lamination adhesive changes by a factor of less than about 2 within a range of 10 to 90 per cent relative humidity and over a temperature range of 10 to 50 ° C.

[c35] An electro-optic display according to claim 32 wherein the lamination adhesive has a thickness in the range of about 12 to about 18 μ m.

[c36] An electro-optic display according to claim 35 wherein the lamination adhesive has a thickness in the range of about 13 to about 17 μ m.

[c37] An electro-optic display according to claim 32 wherein the lamination adhesive has a shear modulus at 120 ° C of not more than about 0.2 megaPascal.

- [c38] An electro-optic display according to claim 32 wherein the ultra-violet stabilizer is a hindered amine light stabilizer.
- [c39] An electro-optic display according to claim 32 wherein the light absorbing material comprises a pigment.
- [c40] An electro-optic display according to claim 39 wherein the light absorbing material comprises at least one of carbon black and magnetite.
- [c41] An electro-optic display according to claim 32 wherein the lamination adhesive has a volume resistivity of from about 10^8 to about 10^{12} ohm cm at 25 ° C.
- [c42] An electro-optic display according to claim 41 wherein the lamination adhesive has a volume resistivity of from about 10^9 to about 10^{11} ohm cm at 25 ° C.
- [c43] An electro-optic display according to claim 42 wherein the lamination adhesive has a volume resistivity of from about 3×10^9 to about 3×10^{10} ohm cm at 25 ° C.
- [c44] An electro-optic display according to claim 32 wherein the lamination adhesive is essentially free from aromatic organic materials.
- [c45] A process for preparing an electro-optic display by providing a first subassembly comprising a solid electro-optic layer and a first substrate, providing a second subassembly comprising a second substrate, at least one of said subassemblies comprising an electrode, and laminating the two subassemblies to one another with a lamination adhesive so that the electro-optic layer is disposed between the first and second substrates, the lamination adhesive being characterized by any one or more of the following:
- (a) having a volume resistivity, measured at 10 ° C, which does not change by a factor of more than about 3 after being held at 25 ° C and 45 per cent relative humidity for 1000 hours;
 - (b) having a peel strength from an electrode material in contact with the lamination adhesive of at least about 2 lb/inch;
 - (c) the volume resistivity of the lamination adhesive changes by a factor of less than about 10 within a range of 10 to 90 per cent relative humidity and over a

temperature range of 10 to 50 ° C;

(d) the lamination adhesive has a thickness in the range of about 10 to about 20 μ m;

(e) the lamination adhesive has a shear modulus at 120 ° C of not more than about 1 megaPascal;

(f) the product of the dielectric constant and the volume resistivity of the lamination adhesive is not greater than the product of the dielectric constant and the volume resistivity of the electro-optic medium within a range of 10 to 90 per cent relative humidity and over a temperature range of 10 to 50 ° C;

(g) comprising an ultra-violet stabilizer;

(h) comprising a light absorbing material.

[c46] A process according to claim 45 wherein the lamination adhesive is applied to the electro-optic layer and the two subassemblies are thereafter laminated together.

[c47] A process according to claim 46 wherein the lamination adhesive is coated, in liquid or semi-solid form, on to a release sheet, converted to a solid layer on the release sheet, the combined release sheet and lamination adhesive are laminated to the electro-optic layer and thereafter the release sheet is removed from the lamination adhesive before the two subassemblies are laminated together.

[c48] An electrophoretic display comprising first and second substrates, and a lamination adhesive layer and a layer of electrophoretic material disposed between the first and second substrates, the electrophoretic material comprising a plurality of capsules, each capsule comprising a capsule wall and an internal phase encapsulated within the capsule wall, the internal phase comprising electrically charged particles suspended in a suspending fluid and capable of moving through the fluid on application of an electric field to the electrophoretic material, the lamination adhesive being characterized by any one or more of the following:

(a) the product of the dielectric constant and the volume resistivity of the lamination adhesive is from about 0.01 to about 100 times the product of the

dielectric constant and the volume resistivity of the suspending fluid;
(b) the ratio of the dielectric constant of the lamination adhesive to the dielectric constant of the suspending fluid within the temperature range of from 10 to 50 ° C does not vary from this ratio at 25 ° C by more than about 2 per cent;
(c) the ratio of the volume resistivity of the lamination adhesive to the volume resistivity of the suspending fluid within the temperature range of from 10 to 50 ° C does not vary from this ratio at 25 ° C by more than a factor of about 100;
(d) the solubility of the suspending fluid in the lamination adhesive does not exceed about 1 per cent weight/weight over the range of 10 to 50 ° C;
(e) being substantially free from mobile species.

[c49] An electrophoretic display according to claim 48 wherein the product of the dielectric constant and the volume resistivity of the lamination adhesive is from about 0.1 to about 10 times the product of the dielectric constant and the volume resistivity of the suspending fluid.

[c50] An electrophoretic display according to claim 49 wherein the product of the dielectric constant and the volume resistivity of the lamination adhesive is from about 0.5 to about 2 times the product of the dielectric constant and the volume resistivity of the suspending fluid.

[c51] An electrophoretic display according to claim 48 wherein the ratio of the dielectric constant of the lamination adhesive to the dielectric constant of the suspending fluid within the temperature range of from 10 to 50 ° C does not vary from this ratio at 25 ° C by more than about 1 per cent.

[c52] An electrophoretic display according to claim 48 wherein the ratio of the volume resistivity of the lamination adhesive to the volume resistivity of the suspending fluid within the temperature range of from 10 to 50 ° C does not vary from this ratio at 25 ° C by more than a factor of about 10.

[c53] An electrophoretic display according to claim 52 wherein the ratio of the volume resistivity of the lamination adhesive to the volume resistivity of the suspending fluid within the temperature range of from 10 to 50 ° C does not vary from this ratio at 25 ° C by more than a factor of about 2.

- [c54] An electrophoretic display according to claim 53 wherein the ratio of the volume resistivity of the lamination adhesive to the volume resistivity of the suspending fluid within the temperature range of from 10 to 50 ° C does not vary from this ratio at 25 ° C by more than about 10 per cent.
- [c55] An electrophoretic display according to claim 48 wherein the solubility of the suspending fluid in the lamination adhesive does not exceed about 0.1 per cent weight/weight over the range of 10 to 50 ° C.
- [c56] An electrophoretic display according to claim 55 wherein the solubility of the suspending fluid in the lamination adhesive does not exceed about 0.01 per cent weight/weight over the range of 10 to 50 ° C.
- [c57] An electrophoretic display according to claim 48 wherein the lamination adhesive is substantially free from mobile ionic species.
- [c58] An electrophoretic display according to claim 48 wherein the lamination adhesive is substantially free from surfactants.
- [c59] An electrophoretic display according to claim 48 wherein the lamination adhesive is substantially free from organic solvents.
- [c60] An electrophoretic display according to claim 48 wherein the lamination adhesive is substantially free from biocides.
- [c61] An electrophoretic display according to claim 48 wherein the lamination adhesive is a polymer substantially free from free monomer.
- [c62] An electrophoretic display according to claim 48 wherein the lamination adhesive comprises at least one polyurethane.
- [c63] A process for preparing an electrophoretic display by providing a first subassembly comprising a first substrate and a layer of an electrophoretic medium comprising a plurality of capsules, each capsule comprising a capsule wall and an internal phase encapsulated within the capsule wall, the internal phase comprising electrically charged particles suspended in a suspending fluid and capable of moving through the fluid on application of an electric field to the

electrophoretic medium, providing a second subassembly comprising a second substrate, at least one of said subassemblies comprising an electrode, and laminating the two subassemblies to one another with a lamination adhesive so that the electro-optic layer is disposed between the first and second substrates, the lamination adhesive being characterized by any one or more of the following:

- (a) the product of the dielectric constant and the volume resistivity of the lamination adhesive is from about 0.01 to about 100 times the product of the dielectric constant and the volume resistivity of the suspending fluid;
- (b) the ratio of the dielectric constant of the lamination adhesive to the dielectric constant of the suspending fluid within the temperature over the range of from 10 to 50 ° C does not vary from this ratio at 25 ° C by more than about 2 per cent;
- (c) the ratio of the volume resistivity of the lamination adhesive to the volume resistivity of the suspending fluid within the temperature over the range of from 10 to 50 ° C does not vary from this ratio at 25 ° C by more than a factor of about 100;
- (d) the solubility of the suspending fluid in the lamination adhesive does not exceed about 1 per cent weight/weight over the range of 10 to 50 ° C;
- (e) being substantially free from mobile species.

[c64] A process according to claim 21 wherein the lamination adhesive is applied to the layer of electrophoretic medium and the two subassemblies are thereafter laminated together.

[c65] A process according to claim 64 wherein the lamination adhesive is coated, in liquid or semi-solid form, on to a release sheet, converted to a solid layer on the release sheet, the combined release sheet and lamination adhesive are laminated to the layer of electrophoretic medium, and thereafter the release sheet is removed from the lamination adhesive before the two subassemblies are laminated together.

[c66] A microcell electrophoretic display comprising a substrate having a plurality of closed cavities formed therein, said cavities being at least partially filled with a

electrophoretic medium comprising a plurality of electrically charged particles suspended in a suspending fluid and capable of moving therethrough on application of an electric field to the electrophoretic medium, the microcell electrophoretic display further comprising at least one electrode and a layer of lamination adhesive disposed between the cavities and the electrode, the lamination adhesive being characterized by any one or more of the following:

- (a) having a volume resistivity, measured at 10 ° C, which does not change by a factor of more than about 3 after being held at 25 ° C and 45 per cent relative humidity for 1000 hours;
- (b) having a peel strength from an electrode material in contact with the lamination adhesive of at least about 2 lb/inch;
- (c) the volume resistivity of the lamination adhesive changes by a factor of less than about 10 within a range of 10 to 90 per cent relative humidity and over a temperature range of 10 to 50 ° C;
- (d) the lamination adhesive has a thickness in the range of about 10 to about 20 μ m;
- (e) the lamination adhesive has a shear modulus at 120 ° C of not more than about 1 megaPascal;
- (f) the product of the dielectric constant and the volume resistivity of the lamination adhesive is not greater than the product of the dielectric constant and the volume resistivity of the electro-optic medium within a range of 10 to 90 per cent relative humidity and over a temperature range of 10 to 50 ° C;
- (g) comprising an ultra-violet stabilizer;
- (h) comprising a light absorbing material;
- (i) the product of the dielectric constant and the volume resistivity of the lamination adhesive is from about 0.01 to about 100 times the product of the dielectric constant and the volume resistivity of the suspending fluid;
- (j) the ratio of the dielectric constant of the lamination adhesive to the dielectric constant of the suspending fluid within the temperature over the range of from 10 to 50 ° C does not vary from this ratio at 25 ° C by more than about 2 per cent;
- (k) the ratio of the volume resistivity of the lamination adhesive to the volume resistivity of the suspending fluid within the temperature over the range of from

10 to 50 ° C does not vary from this ratio at 25 ° C by more than a factor of about 100;

(l) the solubility of the suspending fluid in the lamination adhesive does not exceed about 1 per cent weight/weight over the range of 10 to 50 ° C;

(m) being substantially free from mobile species.